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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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EXAMINER

MAGEE, THOMAS J

ART UNIT PAPER NUMBER

2811

DATE MAILED: 05/29/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicant No.

09/490,705

Applicant(s)

UENO, KAZUYOSHI

Examiner

Thomas J. Magee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _____ MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 February 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2 - 11 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2-11 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 16.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections – 35 U.S.C. 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 2 - 5 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Donnelly et al. (US 6,143,658).

5. Regarding Claims 2 - 5, Donnelly et al. disclose (Col. 8, lines 4 – 26) a method for fabricating a device with two levels of wires (metallization) (copper) where an insulating film structure composed of two layers (510,522) (See Figure 5) is formed on top of the first copper deposited in the first via. The Si₃N₄ serves as the etch stop layer with the “insulating film” (SiO₂) formed on top. A second via is formed, terminating at the first metal. Cleaning is done by exposing the substrate to an oxygen or hydrogen plasma, along with a separate “wet” clean by immersing the substrate in an HF solution (Col. 5, lines 16 – 20), followed by a step of cleaning (Col.5, lines 21 – 32) which includes an anneal (or heating) at temperatures less than 250 degrees C and an H₂ gas exposure at a low partial pressure (1 Torr) with low oxygen partial pressure to ensure removal of

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oxidation on the copper surface (Col. 5, lines 31 – 33) with no simultaneous or subsequent formation of copper oxide. Deposition (sputtering) of a barrier metal is done prior to forming copper plugs in the second via.

Claim Rejections – 35 U.S.C. 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 6 – 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Donnelly et al., as applied to Claims 2 – 5 above, and further in view of Activac Technology Inc. Auto 306 Data Sheet.

Donnelly et al. disclose that oxygen partial pressures are approximately 1 Torr and that exposure times are approximately one minute during exposure to an oxygen plasma (sputtering). Donnelly et al. disclose (Col. 5, lines 21 – 30) that the low pressure oxygen annealing at temperatures less than about 250 degrees C before sputtering, but do not disclose that the anneal is done in a sputter deposition system. It is extremely well known, that commercial sputtering systems are equipped with injection capabilities for a variety of gases, and substrate heaters for “annealing” (See for example, Activac Technology Auto 306 Sputtering System Data Sheets, page 3, lines 5 – 7; 22).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the

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invention to use a commercial sputtering system with gas injection and substrate heater to implement in-situ cleaning and annealing of vias prior to barrier layer deposition.

In regard to the temperature of annealing, the value disclosed by Donnelly et al. is proximate that recited in the instant application. It has been ruled by the court that where the claimed ranges "overlap or lie inside ranges disclosed by the prior art," a prima facie case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990).

Similarly, a prima facie case of obviousness exists where the claimed ranges and prior art ranges do not overlap but are close enough that one skilled in the art would have expected them to have the same properties. *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 227 USPQ 773 (Fed. Cir. 1985).

9. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Donnelly et al. in view of Activac Technology Inc. Data Sheets, as applied to Claims 6 – 9 above, and further in view of Takagi et al. (US 6,174,796 B1).

Donnelly et al. disclose (Col. 8, line 18) the use of a hydrogen plasma but do not disclose the use of hydrogen radicals. Further, there are no explicit disclosures concerning the process of deploying the hydrogen plasma. Takagi et al. disclose (Col.10, lines 4 – 13) a method of removing oxide (and other residuals) from surfaces by heating the surfaces in a hydrogen containing atmosphere or in a hydrogen plasma (containing radicals). It would, therefore, have been obvious to one of ordinary skill in the art at the time of the invention to combine Takagi et al., and Activac Technology Inc. Data Sheets with Donnelly et al. to obtain an effective "annealing" step in hydrogen to

remove residuals and oxide remnants from the surface of vias, prior to deposition of a metal lining the vias to reduce the resistance of the lining and further suppress contamination in the chamber (Col. 2, lines 26 – 31).

Response to Arguments

10. Arguments of Applicant with regard to Claims 2 – 11 have been carefully considered, but have been found to be unpersuasive. Further, said arguments are considered moot in terms of the new ground(s) of rejection.

Conclusions

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to **Thomas Magee**, whose telephone number is **(703) 305 5396**. The Examiner can normally be reached on Monday through Friday from 8:30AM to 5:00PM (EST). If attempts to reach the Examiner by telephone are unsuccessful, the examiner's supervisor, **Tom Thomas**, can be reached on **(703) 308-2772**. The fax number for the organization where this application or proceeding is assigned is **(703) 308-7722**.

Thomas Magee
September 5, 2002

Steven Loko
Primary Examiner

